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AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions and listings of claims in the application.

Listing of Claims

1-14. (Canceled)

15. (Previously Presented) A method of controlling a data unit oriented communication between a sender and a receiver operating in accordance with a predetermined communication protocol, said method comprising the steps of:

dividing, by the sender, an amount of data to be sent into a plurality of data units having a structure determined by the protocol;

transmitting initial data units from the sender to the receiver;

acknowledging, by the receiver, correct receipt of the initial data units by returning acknowledgment data units to the sender;

detecting a failure of the receiver to receive at least one data unit by monitoring a time out period by the sender after the at least one data unit is sent, and if no acknowledgment data unit associated with the data unit is received before the time out period expires, triggering a time out mechanism that indicates the failure;

retransmitting, by the sender, the at least one data unit that the receiver failed to receive;

receiving at the sender, an acknowledgment data unit indicating that at least one of the data units was correctly received by the receiver;

determining whether the received acknowledgment data unit indicates that the at least one correctly received data unit was correctly received as a result of the transmitting step or as a result of the retransmitting step, said determining step including the steps of:

determining by the sender, a shortest round trip time associated with the correct receipt of an initial data unit;

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measuring by the sender, a time period between the retransmission of a given data unit and the receipt of a first acknowledgment data unit associated with the given data unit;

comparing the shortest round trip time to the time period between the retransmission of the given data unit and the receipt of the first acknowledgment data unit; and

determining that the at least one data unit was correctly received as a result of the transmitting step if the time period between the retransmission of the given data unit and the receipt of the first acknowledgment data unit is shorter than a predetermined fraction of the shortest round trip;

subsequently transmitting, by the sender, subsequent data units, said subsequent data units being transmitted in accordance with a flow control procedure conducted on the basis of at least one adaptive parameter, said subsequently transmitting step including:

performing an excessive delay response procedure upon determining that the received acknowledgment data unit indicates that the at least one data unit was correctly received as a result of the transmitting step; and

performing a data unit loss response procedure upon determining that the received acknowledgment data unit indicates that the at least one data unit was correctly received as a result of the retransmitting step.

16-34. (Canceled)

35. (Currently Amended) A device system for controlling a data unit oriented communication between a sender and a receiver operating in accordance with a predetermined communication protocol, said device system comprising:

means in the sender for dividing an amount of data to be sent into a plurality of data units having a structure determined by the protocol;

a data unit transmitter that transmits the data units from the sender to the receiver;

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means in the receiver for acknowledging correct receipt of the transmitted data units by returning acknowledgment data units to the sender;

a data loss detection mechanism that detects an apparent failure of the receiver to receive an initial data unit;

flow-control adapting means, responsive to the data loss detection mechanism, for ~~adapting flow control parameters to transmit~~ reducing a congestion window parameter, for transmitting subsequent data units in accordance with a data unit loss response procedure, and for causing the data unit transmitter to retransmit the data unit that the receiver apparently failed to receive;

receiving means in the sender for subsequently receiving an acknowledgment data unit indicating that the data unit that the receiver apparently failed to receive was correctly received by the receiver;

determining means for determining from the received acknowledgment data unit, whether the correctly received data unit was the initial data unit or the retransmitted data unit;

a data unit loss response mechanism for continuing to transmit subsequent data units in accordance with the data unit loss response procedure, in response to a determination that the correctly received data unit was the retransmitted data unit; and

an excessive delay response mechanism for ~~causing the flow control adapting means to adapt the flow control parameters to transmit~~ transmitting subsequent data units in accordance with an excessive delay response procedure, in response to a determination that the correctly received data unit was the initial data unit, wherein the congestion window parameter is increased to compensate at least partially for any reduction of the congestion window parameter made in response to detecting the apparent failure of the receiver to receive the initial data unit.

36. (Currently Amended) The ~~device~~ system of claim 35, wherein the data loss detection mechanism includes:

a first timer in the sender for monitoring a time out period after the at least one data unit is sent, and;

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a time out mechanism that ~~that~~ indicates the failure of the receiver to receive the at least one data unit, said time out mechanism being triggered if no acknowledgment data unit associated with the data unit is received before the time out period expires.

37. (Currently Amended) The ~~device~~ system of claim 35, wherein the data loss detection mechanism includes a duplicate acknowledgment detection mechanism in the sender that detects whether a predetermined number of duplicate acknowledgment data units are received for a transmitted data unit.

38-39. (Canceled)

40. (Currently Amended) The ~~device~~ system of claim 35, wherein the determining means includes:

marking means in the sender for marking the transmitted data units such that an initial data unit can be distinguished from a retransmitted data unit; and

marking means in the receiver for marking the acknowledgment data units such that an acknowledgment data unit associated with an initial data unit can be distinguished from an acknowledgment data unit associated with a retransmitted data unit.

41. (Currently Amended) The ~~device~~ system of claim 40, wherein:

the marking means in the sender includes a first time stamp mechanism that places a time stamp in each transmitted data unit, the time stamp indicating the time the data unit was sent; and

the marking means in the receiver includes a second time stamp mechanism that places the time stamp contained in a given transmitted data unit in the acknowledgment data unit associated with the given transmitted data unit.

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42. (Currently Amended) The ~~device~~ system of claim 40, wherein:
the marking means in the sender places a bit string in each transmitted data unit, the bit string having at least two different values for distinguishing between an original transmission and a retransmission; and

the marking means in the receiver places the bit string contained in a particular transmitted data unit in the acknowledgment data unit associated with the particular transmitted data unit.

43. (Currently Amended) The ~~device~~ system of claim 42, wherein the bit string consists of a single bit.

44. (Currently Amended) The ~~device~~ system of claim 42, wherein the bit string consists of a plurality of bits, such that the bit string is capable of distinguishing between different retransmissions.

45. (Currently Amended) ~~The device of claim 35, wherein the determining means includes:~~

A system for controlling a data unit oriented communication between a sender and a receiver operating in accordance with a predetermined communication protocol, said system comprising:

means in the sender for dividing an amount of data to be sent into a plurality of data units having a structure determined by the protocol;

a data unit transmitter that transmits the data units from the sender to the receiver;

means in the receiver for acknowledging correct receipt of the transmitted data units by returning acknowledgment data units to the sender;

a data loss detection mechanism that detects an apparent failure of the receiver to receive an initial data unit;

flow-control adapting means, responsive to the data loss detection mechanism, for adapting flow control parameters to transmit subsequent data units in accordance

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with a data unit loss response procedure, and for causing the data unit transmitter to retransmit the data unit that the receiver apparently failed to receive;

receiving means in the sender for subsequently receiving an acknowledgment data unit indicating that the data unit that the receiver apparently failed to receive was correctly received by the receiver;

determining means for determining from the received acknowledgment data unit whether the correctly received data unit was the initial data unit or the retransmitted data unit, said determining means comprising:

a first timer in the sender that measures a shortest round trip time associated with the correct receipt of a transmitted data unit;

a second timer in the sender that measures a time period between the retransmission of a given data unit and the receipt of a first acknowledgment data unit associated with the given data unit;

means for comparing the shortest round trip time to the time period between the retransmission of the given data unit and the receipt of the first acknowledgment data unit; and

means for determining that the at least one data unit was correctly received as a result of the transmitting step if the time period between the retransmission of the given data unit and the receipt of the first acknowledgment data unit is shorter than a predetermined fraction of the shortest round trip;

a data unit loss response mechanism for continuing to transmit subsequent data units in accordance with the data unit loss response procedure, in response to a determination that the correctly received data unit was the retransmitted data unit; and

an excessive delay response mechanism for causing the flow-control adapting means to adapt the flow control parameters to transmit subsequent data units in accordance with an excessive delay response procedure, in response to a determination that the correctly received data unit was the initial data unit.

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46. (Currently Amended) The ~~device~~ system of claim 36, wherein the excessive delay response mechanism includes means for adapting the time out period on the basis of a time period measured between transmitting a given data unit and receipt of a first acknowledgment data unit associated with the given data unit.

47-49. (Canceled)

50. (Currently Amended) A method of controlling a data unit oriented communication between a sender and a receiver operating in accordance with a predetermined communication protocol, said method comprising the steps of:

dividing, by the sender, an amount of data to be sent into a plurality of data units having a structure determined by the protocol;

transmitting initial data units from the sender to the receiver;

acknowledging, by the receiver, correct receipt of the initial data units by returning acknowledgment data units to the sender;

detecting an apparent failure of the receiver to receive an initial data unit;

in response to detecting the apparent failure, ~~adapting~~ reducing by the sender, ~~flow control parameters to transmit~~ a congestion window parameter and transmitting subsequent data units in accordance with a data unit loss response procedure;

retransmitting, by the sender, the data unit that the receiver apparently failed to receive;

subsequently receiving at the sender, an acknowledgment data unit indicating that the data unit that the receiver apparently failed to receive was correctly received by the receiver;

determining from the received acknowledgment data unit, whether the correctly received data unit was the initial data unit or the retransmitted data unit;

upon determining that the correctly received data unit was the retransmitted data unit, continuing to transmit subsequent data units in accordance with the data unit loss response procedure; and

upon determining that the correctly received data unit was the initial data unit, ~~adapting by the sender, the flow control parameters to transmit~~ transmitting subsequent

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data units in accordance with an excessive delay response procedure, wherein the congestion window parameter is increased to compensate at least partially for any reduction of the congestion window parameter made in response to detecting the apparent failure of the receiver to receive the initial data unit.

51-52. (Canceled)

53. (Previously Presented) The method of claim 50, wherein the step of detecting an apparent failure of the receiver to receive an initial data unit includes the steps of:

monitoring a time out period by the sender after the initial data unit is sent, and;

if no acknowledgment data unit associated with the initial data unit is received before the time out period expires, triggering a time out mechanism that indicates the apparent failure.

54. (Previously Presented) The method of claim 50, wherein the step of detecting an apparent failure of the receiver to receive an initial data unit includes the steps of:

determining by the sender whether duplicate acknowledgment data units are received for a transmitted data unit; and

if a data unit is acknowledged a predetermined number of times, triggering a duplicate acknowledgment detection mechanism that indicates the apparent failure.

55. (Previously Presented) The method of claim 50, wherein each of the initial data units includes a sequential time stamp, and each of the acknowledgment data units includes the time stamp of the initial data unit that is being acknowledged, wherein the step of determining from the received acknowledgment data unit whether the correctly received data unit was the initial data unit or the retransmitted data unit includes inspecting the time stamp included in the received acknowledgment data unit.

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56. (Currently Amended) A method of controlling a data unit oriented communication between a sender and a receiver operating in accordance with a predetermined communication protocol, said method comprising the steps of:

dividing, by the sender, an amount of data to be sent into a plurality of data units having a structure determined by the protocol;

transmitting initial data units from the sender to the receiver;

acknowledging, by the receiver, correct receipt of the initial data units by returning acknowledgment data units to the sender;

detecting ~~[[a]]~~ an apparent failure of the receiver to receive at least one data unit by monitoring a time out period by the sender after the at least one data unit is sent, and if no acknowledgment data unit associated with the data unit is received before the time out period expires, triggering a time out mechanism that indicates the apparent failure;

reducing a congestion window parameter and transmitting subsequent data units in accordance with a data unit loss response procedure;

retransmitting, by the sender, the at least one data unit that the receiver apparently failed to receive, wherein each retransmitted data unit includes a marker indicating that the retransmitted data unit is a retransmitted data unit;

receiving at the sender, an acknowledgment data unit indicating that one of the data units was correctly received by the receiver, wherein the acknowledgment data unit includes the marker if the data unit correctly received by the receiver was a retransmitted data unit;

determining from the received acknowledgment data unit, whether the correctly received data unit was an initial data unit or a retransmitted data unit by determining whether the marker is present in the acknowledgment data unit; and

subsequently transmitting, by the sender, subsequent data units, said subsequent data units being transmitted in accordance with a flow control procedure conducted on the basis of at least one adaptive parameter, said subsequently transmitting step including:

performing an excessive delay response procedure upon determining that the received acknowledgment data unit indicates that the correctly received data unit was an initial data unit, wherein the congestion window parameter is increased to

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compensate at least partially for any reduction of the congestion window parameter made in response to detecting the apparent failure of the receiver to receive the initial data unit; and

~~performing a~~ continuing to perform the data unit loss response procedure upon determining that the received acknowledgment data unit indicates that the correctly received data unit was a retransmitted data unit.

57. (Currently Amended) A method of controlling a data unit oriented communication between a sender and a receiver operating in accordance with a predetermined communication protocol, said method comprising the steps of:

dividing, by the sender, an amount of data to be sent into a plurality of data units having a structure determined by the protocol;

transmitting initial data units from the sender to the receiver, wherein each initial data unit includes a first marker indicating that the initial data unit is an initial data unit;

acknowledging, by the receiver, correct receipt of the initial data units by returning acknowledgment data units to the sender, wherein the acknowledgment data units include the first marker if the data unit received by the sender was an initial data unit;

detecting ~~[[a]]~~ an apparent failure of the receiver to receive at least one data unit by monitoring a time out period by the sender after the at least one data unit is sent, and if no acknowledgment data unit associated with the data unit is received before the time out period expires, triggering a time out mechanism that indicates the apparent failure;

reducing a congestion window parameter and transmitting subsequent data units in accordance with a data unit loss response procedure;

retransmitting, by the sender, the at least one data unit that the receiver apparently failed to receive, wherein each retransmitted data unit includes a second marker indicating that the retransmitted data unit is a retransmitted data unit;

receiving at the sender, an acknowledgment data unit indicating that one of the data units was correctly received by the receiver, wherein the acknowledgment data unit includes the first marker if the data unit correctly received by the receiver was an initial

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data unit, and includes the second marker if the data unit correctly received by the receiver was a retransmitted data unit;

determining from the received acknowledgment data unit, whether the correctly received data unit was an initial data unit or a retransmitted data unit by determining whether the acknowledgment data unit includes the first or the second marker, respectively; and

subsequently transmitting, by the sender, subsequent data units, said subsequent data units being transmitted in accordance with a flow control procedure conducted on the basis of at least one adaptive parameter, said subsequently transmitting step including:

performing an excessive delay response procedure upon determining that the received acknowledgment data unit indicates that the correctly received data unit was an initial data unit, wherein the congestion window parameter is increased to compensate at least partially for any reduction of the congestion window parameter made in response to detecting the apparent failure of the receiver to receive the initial data unit; and

~~performing a continuing to perform the data unit loss response procedure~~ upon determining that the received acknowledgment data unit indicates that the correctly received data unit was a retransmitted data unit.

58. (Previously Presented) The method of claim 57, wherein the first and second markers include a single bit.

59. (Previously Presented) The method of claim 57, wherein the first and second markers are time stamps indicating a time of transmission of the initial data unit and the retransmitted data unit, respectively.

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60. (Currently Amended) A method of controlling a data unit oriented communication between protocol peers operating in accordance with a predetermined communication protocol, said method comprising the steps of:

dividing, by a first protocol peer, an amount of data to be sent into a plurality of data units having a structure determined by the protocol;

transmitting initial data units from the first protocol peer to a second protocol peer;

acknowledging, by the second protocol peer, correct receipt of the initial data units by returning acknowledgment data units to the first protocol peer;

detecting an apparent failure of the second protocol peer to receive an initial data unit;

in response to detecting the apparent failure, adapting flow control parameters, reducing a congestion window parameter, and transmitting to transmit subsequent data units in accordance with a data unit loss response procedure;

retransmitting, by the first protocol peer, the data unit that the second protocol peer apparently failed to receive;

subsequently receiving at the first protocol peer, one or more acknowledgment data units indicating that the data unit that the second protocol peer apparently failed to receive was correctly received by the second protocol peer;

determining from the one or more received acknowledgment data units, whether the correctly received data unit was the initial data unit or the retransmitted data unit;

upon determining that the correctly received data unit was the retransmitted data unit, continuing to transmit subsequent data units in accordance with the data unit loss response procedure; and

upon determining that the correctly received data unit was the initial data unit, adapting the flow control parameters ~~to transmit~~ and transmitting subsequent data units in accordance with an excessive delay response procedure, wherein the congestion window parameter is increased to compensate at least partially for any reduction of the congestion window parameter made in response to detecting the apparent failure of the receiver to receive the initial data unit.

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61. (New) A method of controlling a data unit oriented communication between a sender and a receiver operating in accordance with a predetermined communication protocol, said method comprising the steps of:

dividing, by the sender, an amount of data to be sent into a plurality of data units having a structure determined by the protocol;

transmitting initial data units from the sender to the receiver, said transmitting step including placing a timestamp in each of the data units when each data unit is transmitted;

acknowledging, by the receiver, correct receipt of the initial data units by returning acknowledgment data units to the sender, where each of the acknowledgment data units includes the timestamp of the initial data unit being acknowledged;

detecting an apparent failure of the receiver to receive at least one initial data unit;

retransmitting, by the sender, the at least one data unit that the receiver apparently failed to receive, said retransmitting step including placing a timestamp in the retransmitted data unit and storing the timestamp of the retransmitted data unit in the sender;

receiving at the sender, an acceptable acknowledgment data unit indicating that the data unit that the receiver apparently failed to receive was correctly received by the receiver;

determining whether the received acknowledgment data unit is associated with the initial data unit or the retransmitted data unit, said determining step including the steps of:

comparing the timestamp received in the acknowledgment data unit with the stored timestamp of the retransmitted data unit;

determining that the received acknowledgment data unit is associated with the retransmitted data unit if the timestamp received in the acknowledgment data unit matches the stored timestamp of the retransmitted data unit; and

determining that the received acknowledgment data unit is associated with the initial data unit if the timestamp received in the acknowledgment data unit is smaller than the stored timestamp of the retransmitted data unit;

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subsequently transmitting, by the sender, subsequent data units, said subsequent data units being transmitted in accordance with a flow control procedure conducted on the basis of at least one adaptive parameter, said subsequently transmitting step including:

performing a data unit loss response procedure upon determining that the received acknowledgment data unit is associated with the retransmitted data unit; and

performing an excessive delay response procedure upon determining that the received acknowledgment data unit is associated with the initial data unit.

62. (New) The system of claim 35, wherein the excessive delay response mechanism also increases a time-out period to reduce the likelihood of further false lost packet detections.

63. (New) The system of claim 35, wherein the excessive delay response mechanism avoids retransmitting data units that have already been transmitted.

64. (New) The method of claim 50, wherein the excessive delay response procedure avoids retransmitting data units that have already been transmitted.

65. (New) The method of claim 60, wherein the excessive delay response procedure avoids retransmitting data units that have already been transmitted.

66. (New) The method of claim 50, wherein the step of determining whether the correctly received data unit was the initial data unit or the retransmitted data unit includes:

marking the transmitted data units by the sender such that an initial data unit can be distinguished from a retransmitted data unit; and

marking the acknowledgment data units by the receiver such that an acknowledgment data unit associated with an initial data unit can be distinguished from an acknowledgment data unit associated with a retransmitted data unit.

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67. (New) The method of claim 66, wherein:

the step of marking the transmitted data units by the sender includes placing a bit string in each transmitted data unit, the bit string having at least two different values for distinguishing between an original transmission and a retransmission; and

the step of marking the acknowledgment data units by the receiver includes placing the bit string contained in a particular transmitted data unit in the acknowledgment data unit associated with the particular transmitted data unit.

68. (New) The method of claim 67, wherein the bit string consists of a single bit.